but during the moments of best definition it appeared to me that these three nuclei were approximately circular, although I could not trace any distinct borders to them.   They were all surrounded by the lighter background, and at no point did they touch the inner edge of the penumbra, but were always separated from it by an appreciable margin.

At first I supposed that what I saw was simply an effect of irradiation, but I satisfied myself that the phenomena were real.

The telescope is an equatorial refractor, by T. Cooke & Sons, of York, of 6 inches aperture, and the powers employed were from 60 to 200.

The contrast in colour between the black nuclei and the remainder of the umbra was very slight, but still it was distinctly perceptible, and by careful looking could be traced wherever it extended.   These nuclei have been seen by former observers, and may possibly exist in every spot if we could but see them ; but how they are caused or whether they are phenomena of growth or of decay must be left to the investigations of future observers.

Discordances of Index Errors of the Madras Mural Circle in the years 1834-1842 inclusive. By A. M. W. Downing, M.A., D.Sc., F.R.S.

In the course of the re-reduction of Taylor's Madras Observations, on which I am engaged, it became necessary to decide whether it was possible to make the declinations independent determinations, or whether it was necessary to make them differential with regard to an adopted standard catalogue, as Taylor had done.   The materials for the former course are supplied by the observations of the " Reflecting Collimator," or of the nadir, as we should call it, which were commenced on 1834 August 11, and were continued (with some interruptions) from that date down to the end of the series of observations in 1842.

As the observations which were combined to form the Madras General Star Catalogue (which are those with which we are here concerned) extend from 1831 to 1842, it became necessary to ascertain whether the index errors deduced from the nadir bore any fixed or other determinable relation to those deduced from comparing the corrected circle-readings with the declinations of the Standard Catalogue.   It would thus be possible to determine whether index errors corresponding to the nadir could be carried back to the commencement of the series of observations, and carried through the gaps in the nadir observations.

The adopted north latitude of the Madras Observatory, which has been applied to the nadir observations to obtain the index errors is $13° 4' 8''\cdot1$.   The substantial accuracy of this value

appears probable from a re-discussion of the direct and reflection observations of stars given on pp. 94, 95 of vol. i. of the Madras Observations. The corrected value of the latitude thus obtained is $13° 4' 8''\cdot04$.

The standard declinations with which the corrected circle-readings are compared, to deduce the index errors from star observations, are those of Auwers' Mean System (*Ast. Nach.* 1536), and are found by applying the corrections given on page 12 of *Publication der Astronomischen Gesellschaft*, xiv. to the declinations of the Fundamental Catalogue published in the same volume. The stars used for index-error purposes are those of the Fundamental Catalogue situated to the south of dec. $+55°$.

The following table gives the mean correction to the index error from the nadir deduced from the index error from stars observed on the same day for each year of the series :—

Year.	No. of Comparisons.	Mean Correction.
1834	70	$-1''\cdot56$ (from Aug. 11)
1835	277	$-0\cdot67$
1836	253	$-1\cdot28$
1837	225	$-1\cdot31$
1838	199	$-0\cdot46$
1839	115	$-1\cdot42$
1840	107	$-0\cdot56$
1841	70	$-0\cdot53$ (to Sept. 25)
1842	127	$-0\cdot87$ (from May 17)

The mean correction for the entire series is $-0''\cdot96$, and the total number of comparisons is 1443.

The apparent correction to the adopted latitude is therefore $+0''\cdot96$.

The next table shows the result of separating the observations in the four quarters of each year in order to see whether there is any marked change in the correction depending on the season of the year.

	1834.	1835.	1836.	1837.	1838.	1839.	1840.	1841.	1842.
I.	...	$-1''\cdot32$	$-1''\cdot31$	$-1''\cdot68$	$-0''\cdot89$	$-1''\cdot74$	$-0''\cdot12$	$-0''74$	...
II.	...	$-0\cdot82$	$-1\cdot86$	$-1\cdot07$	$+0\cdot05$	$-1\cdot69$	$-1\cdot04$	$-0\cdot84$	$-2\cdot13$
III.	$-1\cdot07$	$+0\cdot21$	$-1\cdot06$	$-1\cdot08$	$-0\cdot02$	$-1\cdot41$	$-0\cdot54$	$-0\cdot04$	$-0\cdot55$
IV.	$-1\cdot82$	$-0\cdot65$	$-0\cdot80$	$-1\cdot24$	$-1\cdot02$	$-1\cdot00$	$-0\cdot55$	...	$-0\cdot58$

The mean correction, the discordance of each mean result from the mean of all, and the R.A. at 10 hours M.T. (representing roughly the average time of star observations) for each group are shown in the next table.

	Mean Correction.	Discordance from Mean.	R.A. at 10 hrs. h			Mean Correction.	Discordance from Mean.	R.A. at 10 hrs. h
I.	$-1''11$	$-0''14$	7		III.	$-0''62$	$+0''35$	19
II.	$-1·18$	$-0·21$	13		IV.	$-0·96$	$+0·01$	1

These annual discordances are of similar amount, though of quite dissimilar phase, to those found by Auwers from a comparison of Taylor's Catalogue (the declinations of which depend fundamentally on those of Pond's Catalogue of 1830) with the Fundamental Catalogue of the *Astronomische Gesellschaft.* The following table is deduced from his results (*Ast. Nach.* 3195):—

R.A. h	Correction to Taylor.	R.A. h	Correction to Taylor.
7	$+0''04$	19	$+0''02$
13	$+0·23$	1	$-0·32$

In view of the discordances here exhibited, both of a constant and periodic nature, it appears preferable to form the adopted index errors from a comparison of the corrected circle readings with the declinations of the Standard Catalogue rather than to attempt the formation of independent declinations which would involve so many elements of uncertainty. The former is consequently the course that has been adopted.

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Cloud Statistics for Stations in India near the Path of the Moon's Shadow on 1898 *January* 21-22. By A. M. W. Downing, M.A., D.Sc., F.R.S.

Thanks to the kindness of Mr. J. Eliot, F.R.S., Meteorological Reporter to the Government of India, the cloud observations which are embodied in this paper were made at various points near the track of the total eclipse of next January, so as to be a guide to intending observers in the choice of stations.

My request for these observations for the latter part of 1894 January did not reach Mr. Eliot sufficiently early to enable him to make as complete returns for that year as he has done for the corresponding periods of 1895, 1896, and 1897. With the very complete organisation at his command, Mr. Eliot has been able (an opportunity of which he has not been slow to avail himself) to render a signal service to the science of astronomy.

The observations communicated to me consist of the hourly observation of the amount of cloud at each hour of the interval specified at the head of each yearly column in the following